712CD

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Original title on 712 A/B:

Enough Already! Balancing the data resolution, temporal and spatial, issues between the data providers and the data users

If the title was revised please list the original title above and the revised title here:

Balancing Data Resolution Issues Between Providers and Users

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WORKING GROUP: 10	**DEMONSTRATION:**
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Balancing Data Resolution Issues Between Providers and Users

75th MORS Symposium
12-14 June 2007

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14 June 2007

Outline

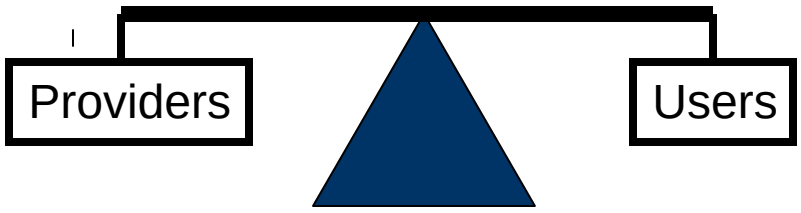
- **Background**
- **LPD 17 Testbed Example**
  - Process used to determine required resolution
  - Uses of Interpolation
  - Integration of Models
- **General Resolutions / Recommendations**
- **Questions**

Background

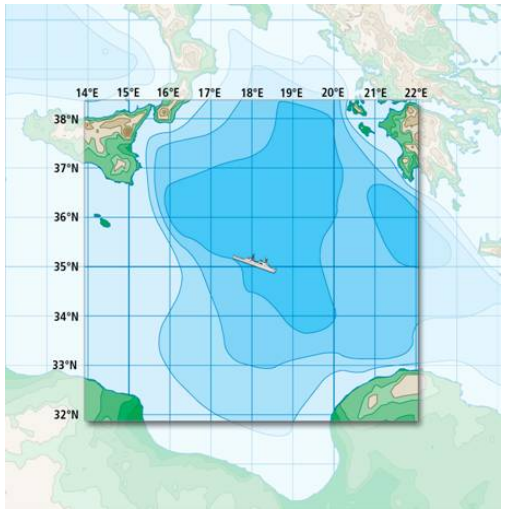
Navy Enterprise (PEO IWS) PRA Testbed (M&S)

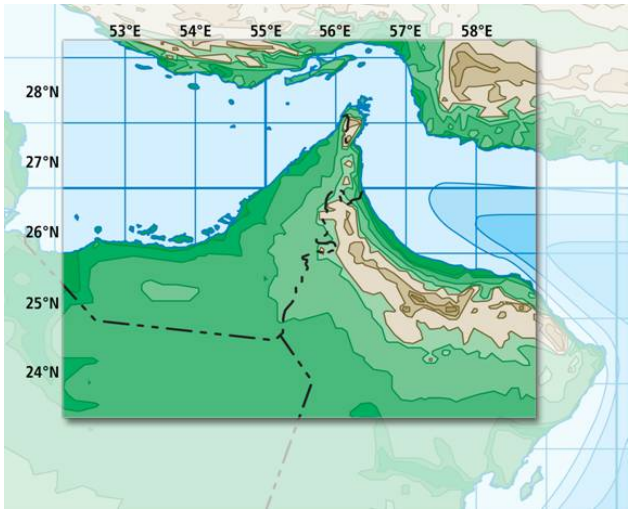
- **Test & evaluate the performance of the Ship Self Defense System (SSDS) against threat raids**
- **Analyze how the environment affects the performance of the individual military entities as well as the SSDS**
- **Provide the integrated, consistent and sufficient scenario natural environment representation required.**

- **Why sufficient?**
  - Conserves resources
  - Avoids risk
- **How much resolution is sufficient?**
  - Balance between providers and users



Exemplar - LPD 17 Ship Class



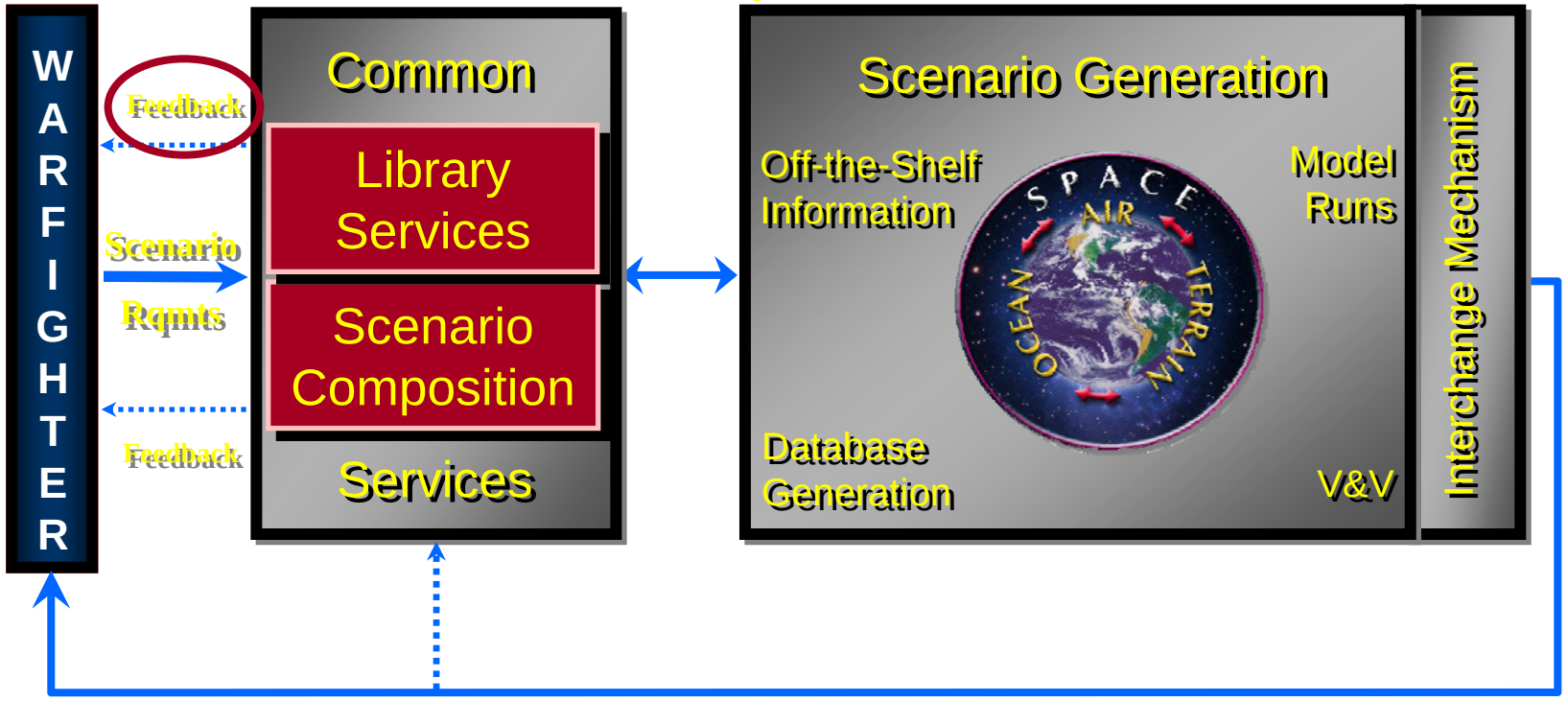


- **Two Locations – Central Mediterranean & Straits of Hormuz**
- **Two Seasons – Summer & Winter**
- **Five Times of Day – Sunrise, Noon, Mid-afternoon, Sunset & Midnight**
- **Four Domains – Air, Sea Surface, Terrain & Ephemeris**
- **8 Primary Radials, or Line of Sight (LOS) directions from Ship**
- **Sea State 3**

Integrated Natural Environment Authoritative Representation Process (INEARP)

The Challenge

Create a physically consistent, cross-domain authoritative "ground truth" of the natural environment that meets user requirements but does not <u>unnecessarily</u> overly exceed them. Put your resources where they're needed.



Determining the Balance

- **Radar performance can be strongly affected by weather conditions**
- **Radar *model* performance is very sensitive to atmosphere data variability and, hence, resolution in data**
- **Modified Refractivity is the critical effects parameter**
  - obtained from a standard algorithm
- **Need to work with the radar model developers closely**
  - Offer multiple solutions, work in cycles

Modified Refractivity

$$MR = \frac{77.6\,p}{T} + \frac{e_s * 3.73 * 10^5}{T^2} + 0.157H$$

where e_s = the partial pressure of water vapor in hPa

$$e_s = \frac{rh * 6.105 * e^x}{100},$$

,

$$x = 25.22 * \frac{(T - 273.2)}{T} - 5.31 * \log_e\left(\frac{T}{273.2}\right),$$

p = barometric pressure in hPa,
T = absolute temperature in Kelvin,
rh = relative humidity in percent and
H = altitude in meters

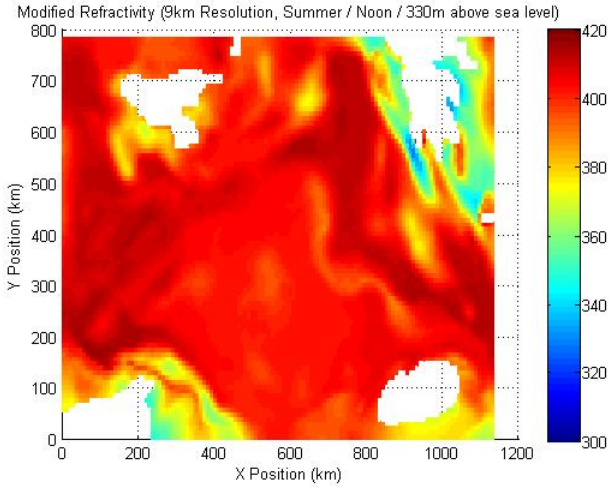
Round 1 Sets

- **Early rounds of delivered data:**
  - 27km resolution (over 2052km x 1566km grid) of modified COAMPS data (30 vertical levels)
    - Modifications included changes to modified refractivity, conditioning of variables, etc.
  - Also delivered: 9km resolution data sets (1143km x 792km grid)

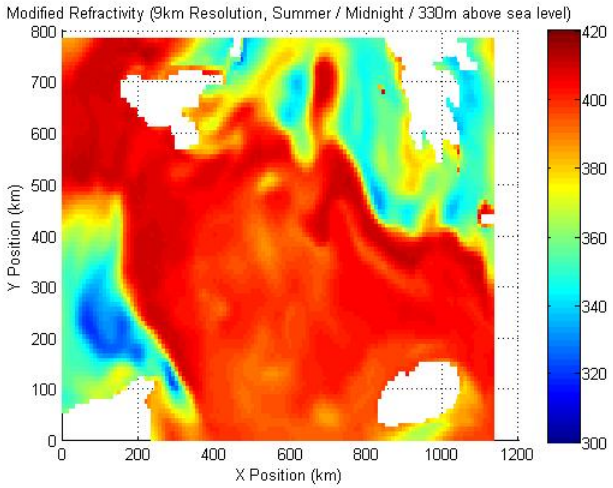
Modified Refractivity
Summer & Winter – Noon & Midnight

Summer

Noon

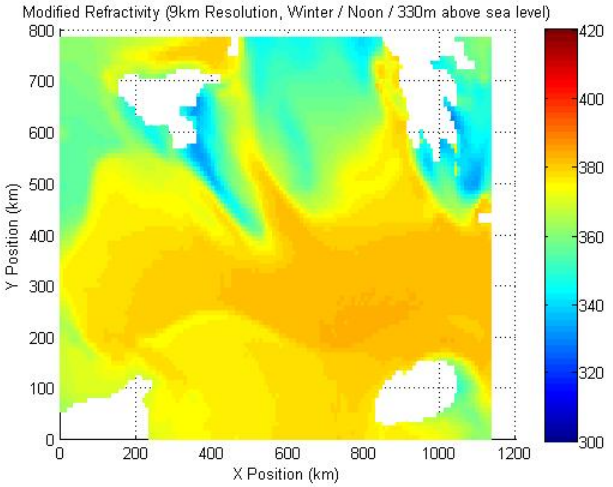


Midnight



Winter

Noon



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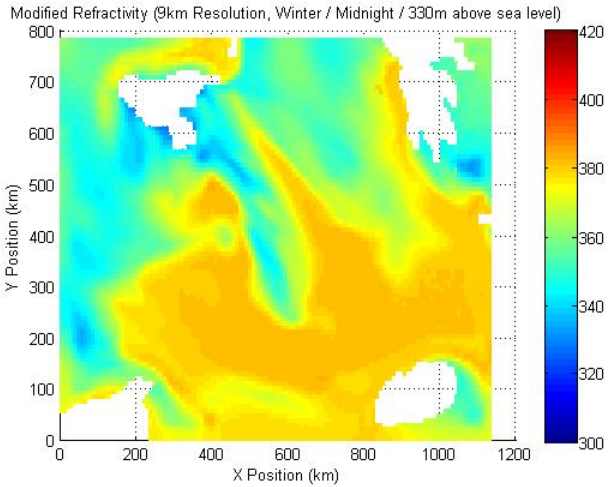
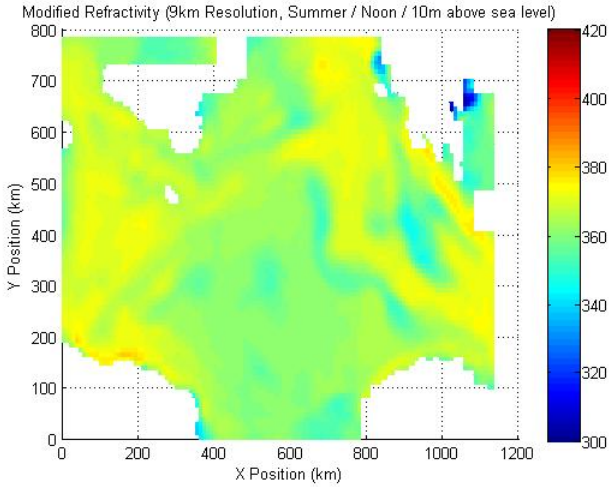
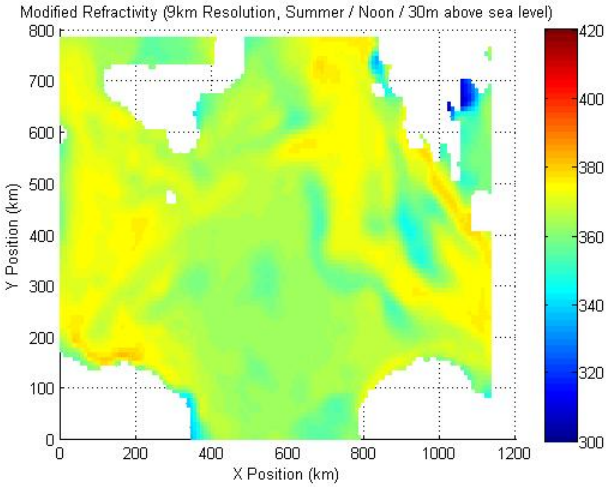
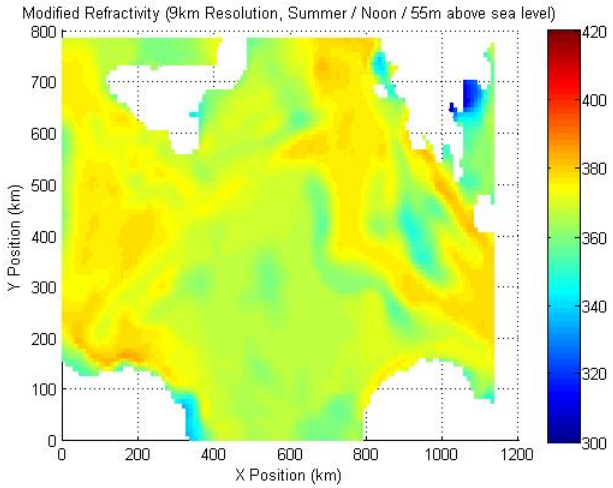
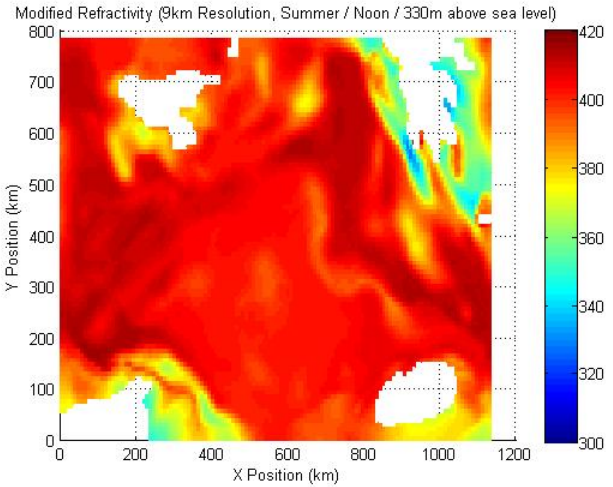


Modified Refractivity Summer/Noon @ 10, 30, 55 & 330 m

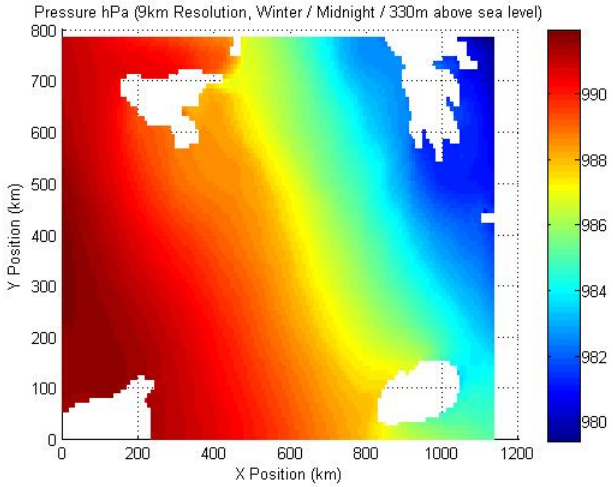


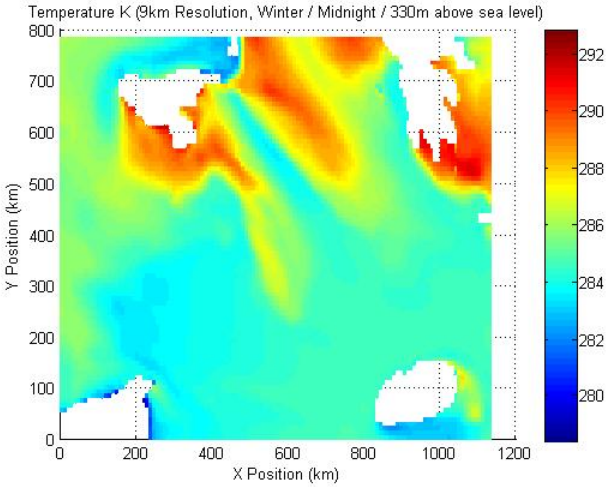


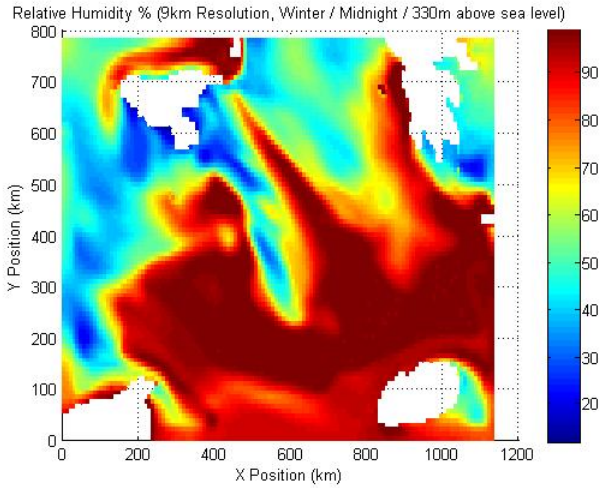


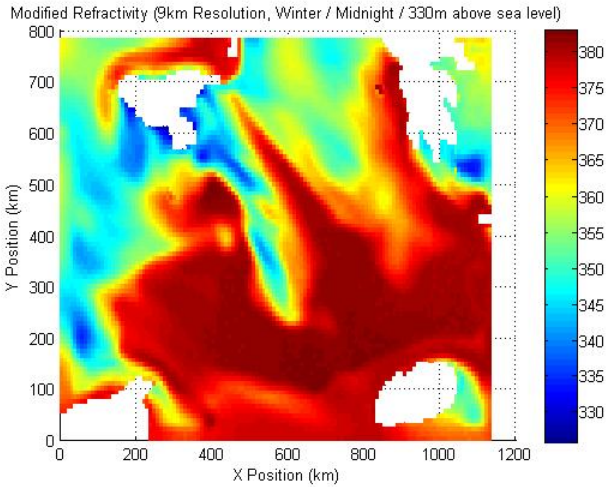


Atmospheric Parameters
Winter Midnight @ 330 m





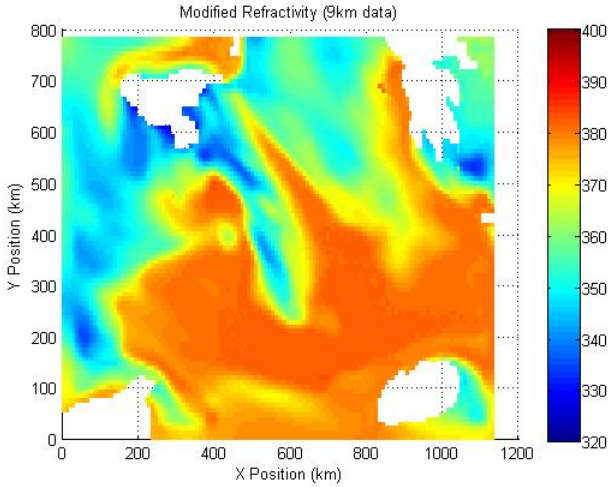


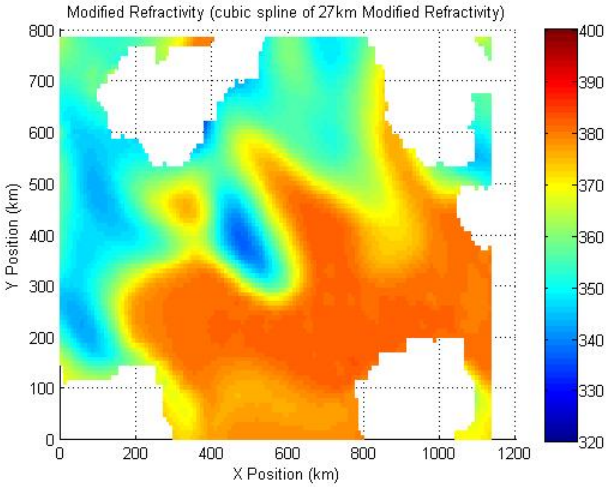


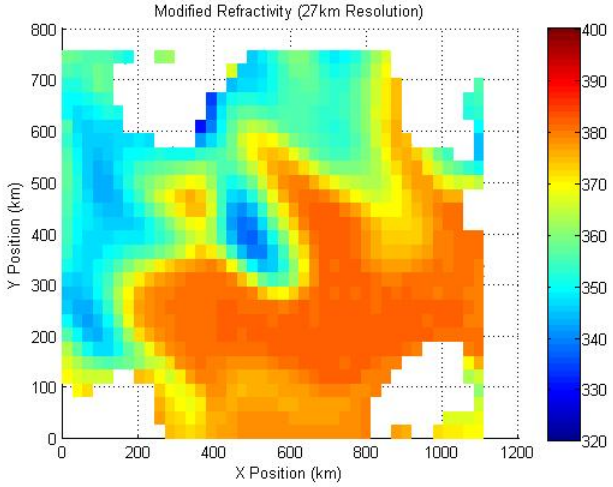
Round 2: Interpolation and Radials

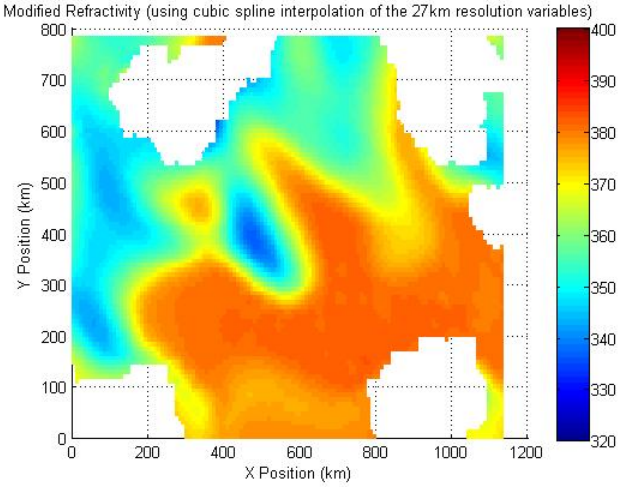
- **Radar models wanted more resolution**
  - Why?
  - What was most important for the data to capture?
- **Consistent interpolation methods between developers**
- **Even if COAMPS rerun @ higher resolution – essential problem still there**
  - Offered solutions
    - Horizontally: finer grid vs. along radials, cubic spline vs. linear
    - Vertically: interpolation vs. none, use of evaporative duct model for the lowest levels
      - What duct model?

Horizontal Interpolation Techniques
Winter Midnight @ 330 m

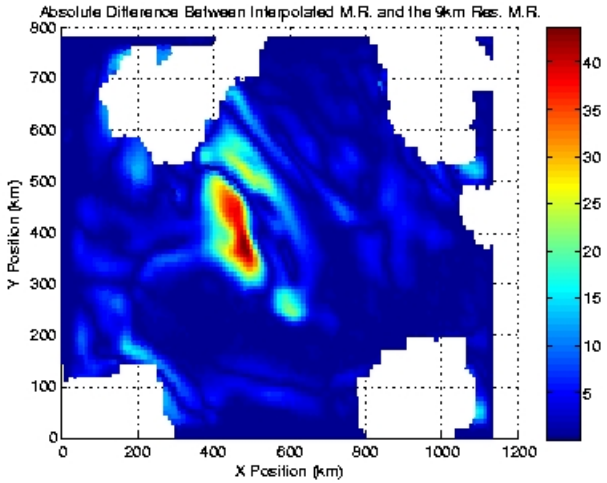


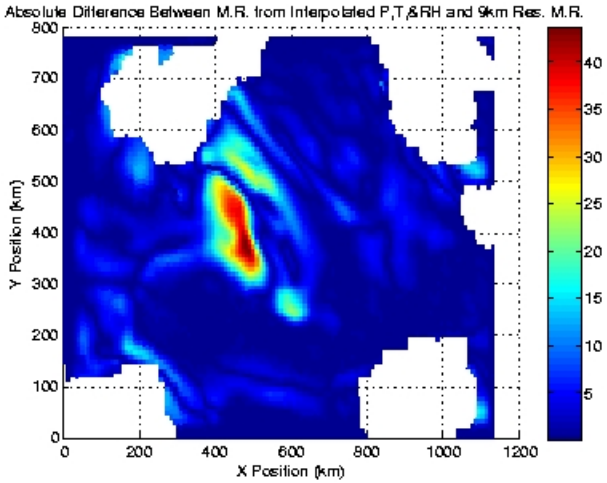




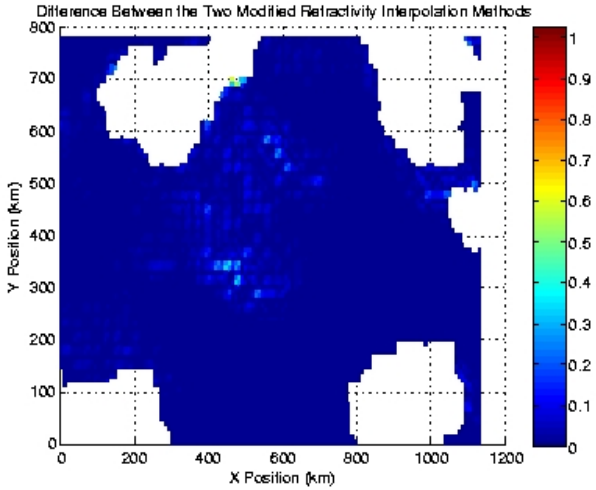


Horizontal Interpolation Techniques II
Winter Midnight @ 330 m

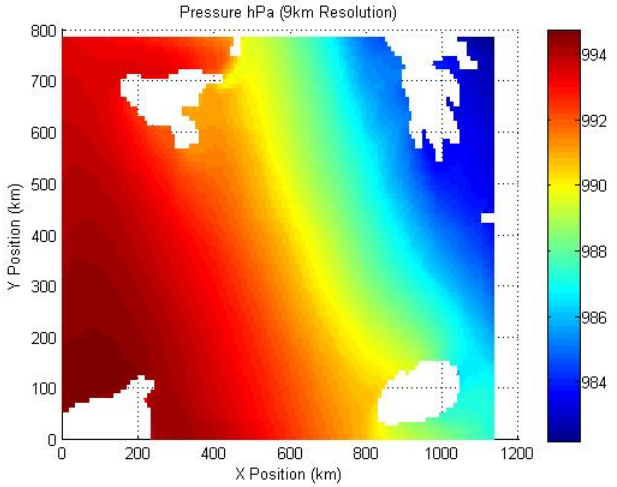


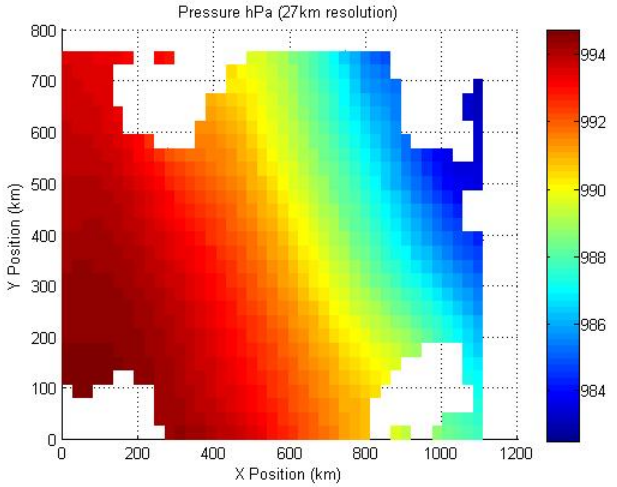


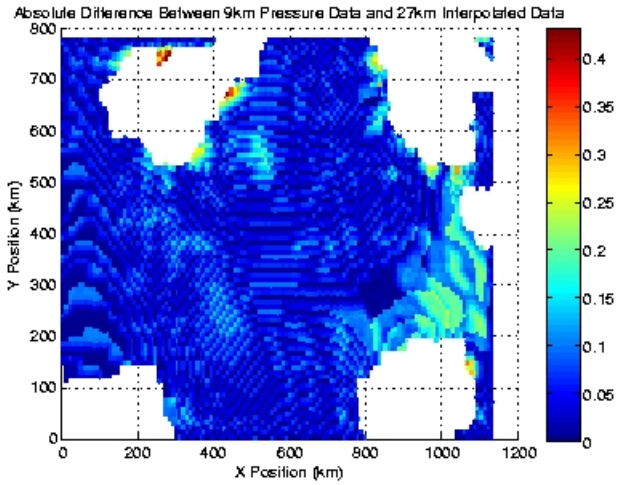
- **Surprised to see no real difference in the results**
- **Geography specific?**

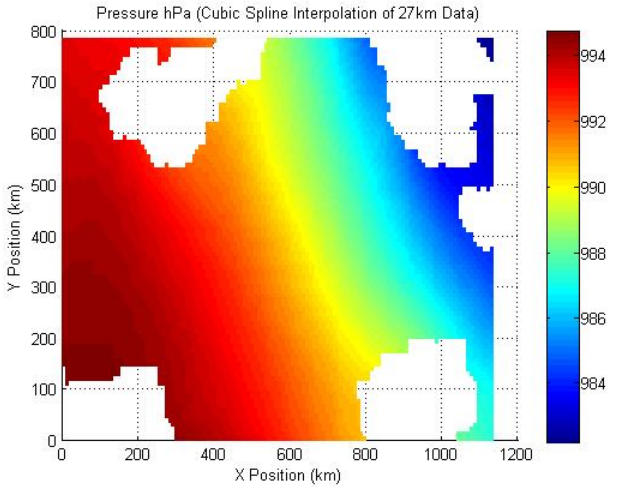


Pressure
Winter Noon @ 330 m

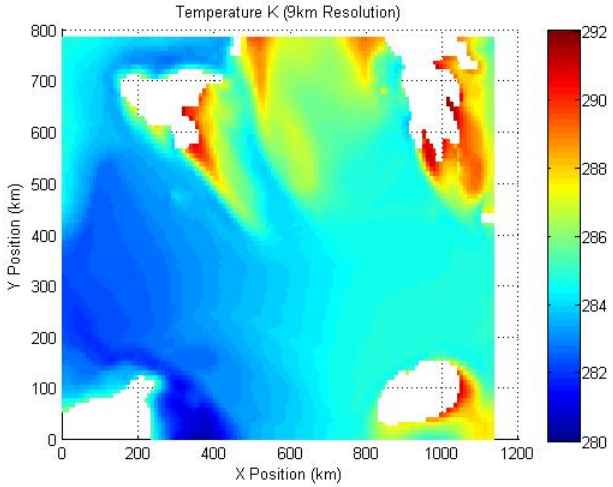


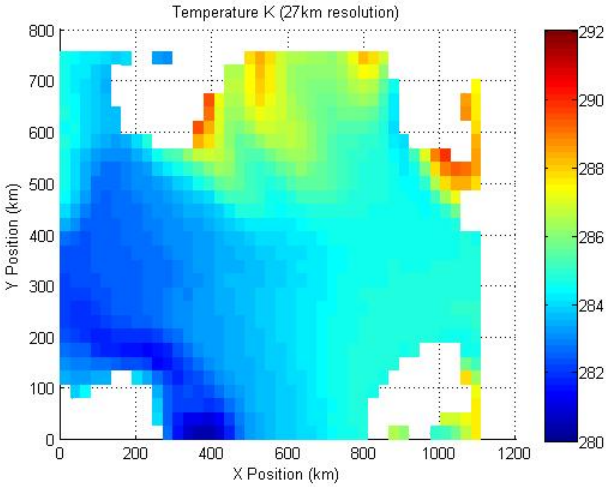


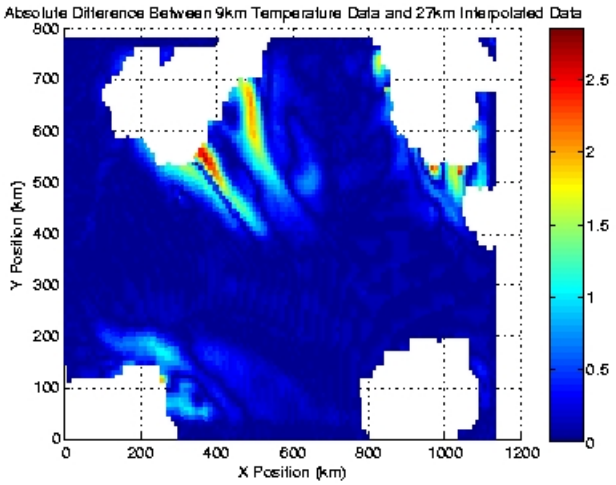


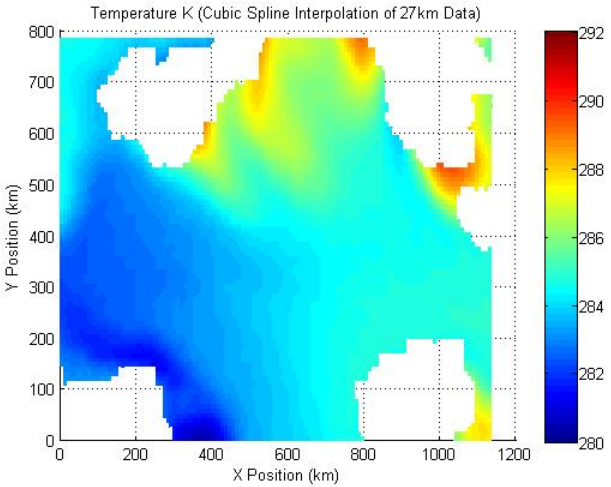


Temperature
Winter Noon @ 330 m

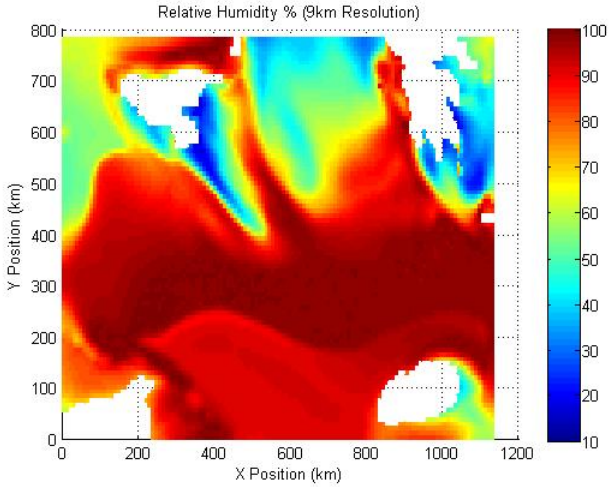


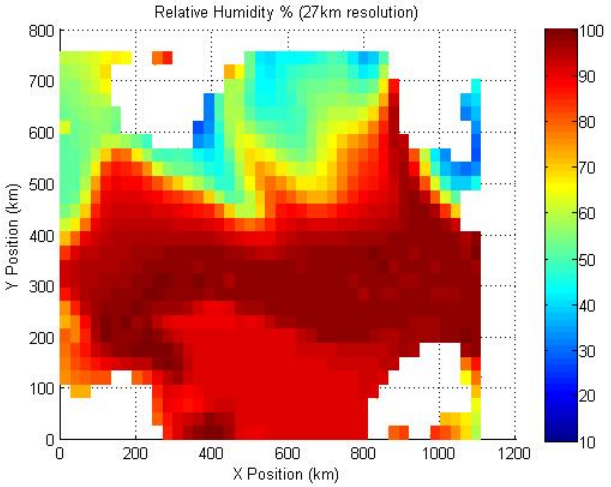


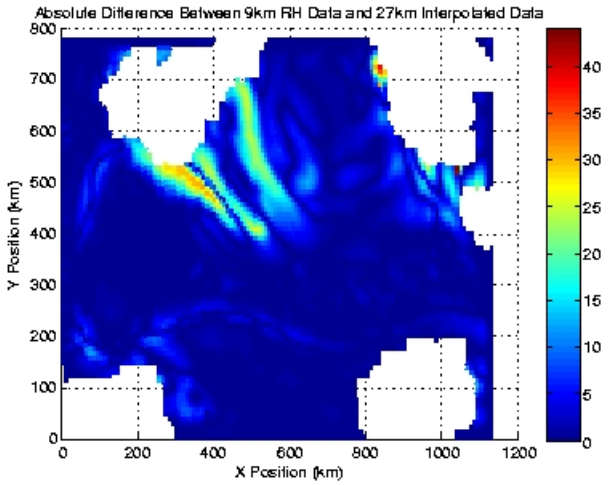


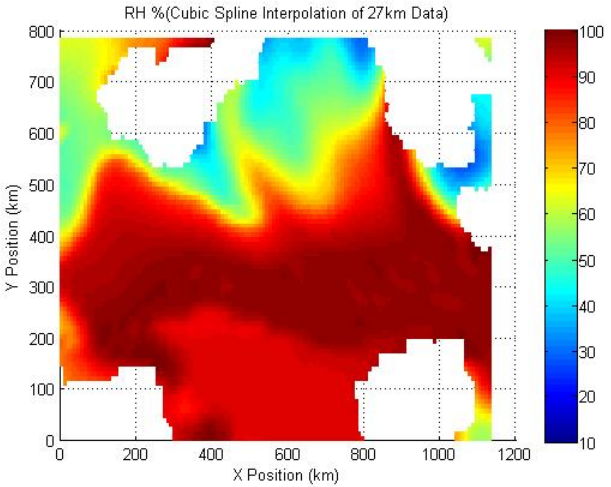


Relative Humidity
Winter Noon @ 330 m



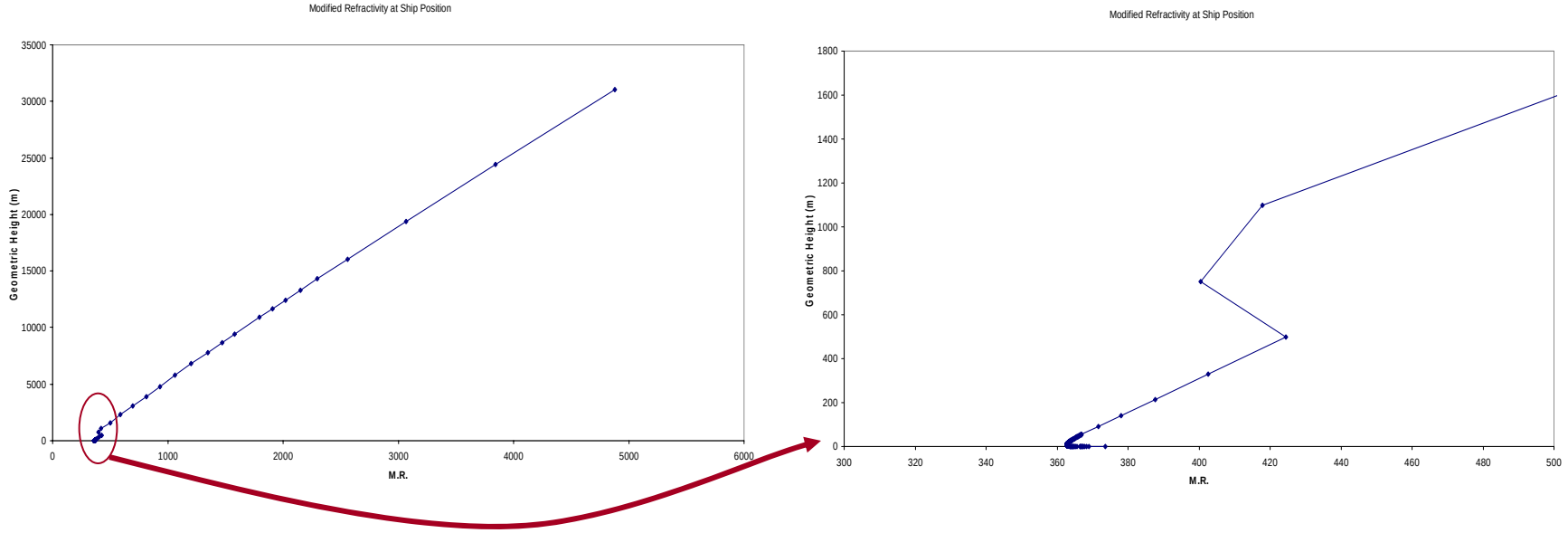






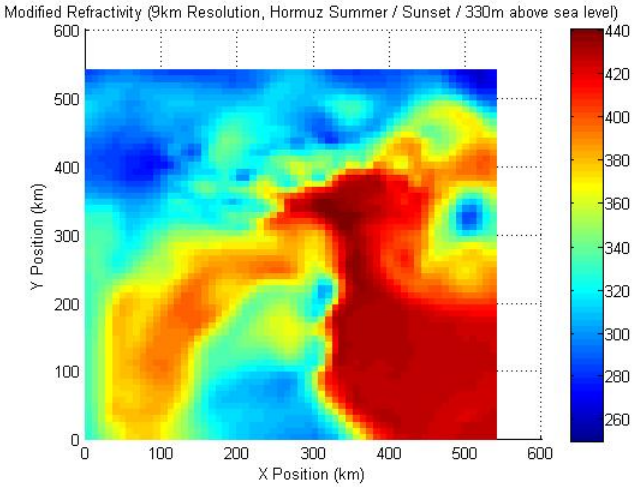
Sample Vertical Data

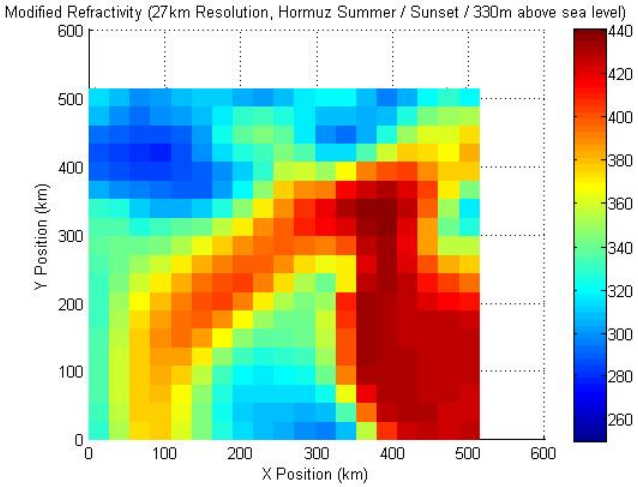
Summer Noon Data (Provided at Every Point Along Radials)

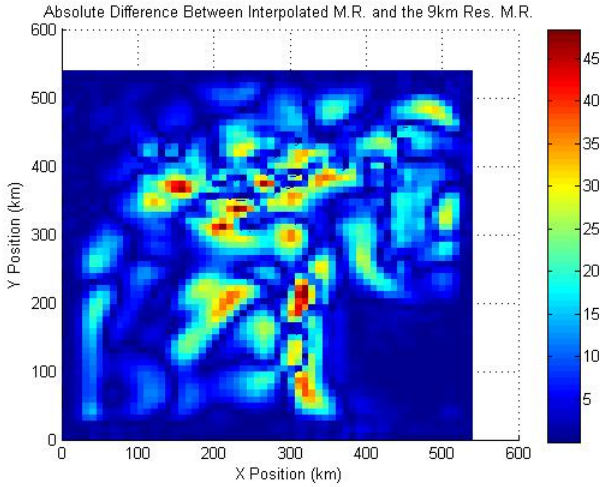


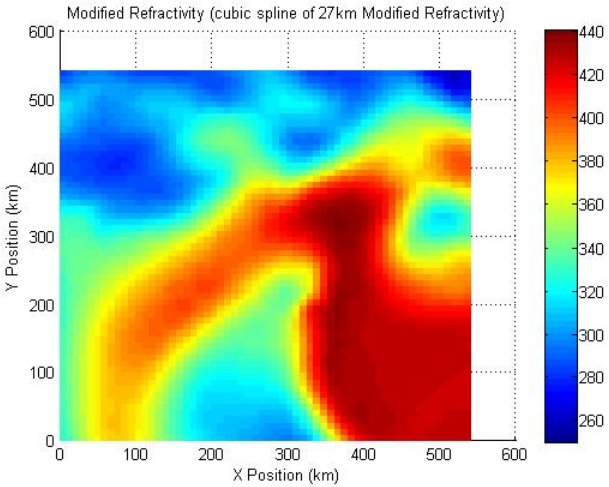
- **Blended Evaporative Duct Model (provided by JHU/APL) with COAMPS data**
- **Interpolation Offered and demonstrated to smooth out the corners, but the radar models already handled it - no need.**

Straits of Hormuz
Summer Sunset @330 m









Next Round and Future Ship Classes

- **Next Round Plan of Action**
  - Blending the 9km with 27km data
    - Increase LOS while maintaining local high resolution
  - Offer more Evaporative Duct models as possibilities for implementation
  - Runs Reduction, and what it could mean for Hormuz
- **Future Ship Classes**
  - Offer More Grid Options
    - Dynamic / Mesh Grid: Higher resolution near ship, log-scale
    - Polar Coordinate Grid

Conclusions

- **Ask Lots of Questions… find out "Why" the users are asking for more.**
- **Cycle as many times as possible**
  - Offer Options Each time… keep finding the answer to "why?"
- **Keep Track of the requirements**
- **Higher resolution does not always provide additional insight into military system performance... What's really important?**
- **Prioritize**
- **The required data resolutions depends on**
  - the parameter
  - The military system
  - The use the military system

- **Questions**